New Hampshire Volunteer Lake Assessment Program

2003 Interim Report for Governors Lake Raymond

NHDES
Water Division
Watershed Management Bureau
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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **GOVERNORS LAKE, RAYMOND,** the program coordinators have made the following observations and recommendations:

Thank you for your hard work sampling the lake this season! The volunteer monitor sampled the deep spot and the tributaries **three** times this season. In addition, the volunteer monitor conducted storm event sampling on one event. Furthermore, the volunteer monitor conducted a shoreline conductivity survey of the pond. As you know, with multiple sampling events each season, and conducting additional sampling in addition to routine deep spot and tributary sampling, we will be able to more accurately detect changes in water quality. Keep up the good work!

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 ug/L.**

  The current year data (the top graph) show that the chlorophyll-a concentration ***decreased*** from June to August, and then ***increased*** from August to September. The chlorophyll-a concentration in June and September was ***greater than*** the state mean, while the concentration in August was ***less than*** the state mean. *(Please note that the deep spot was not sampled in July.)*

The historical data (the bottom graph) show that the 2003 chlorophyll-a mean is ***approximately equal to*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a variable, but overall a slightly decreasing*** in-lake chlorophyll-a trend. Specifically, this indicates that chlorophyll concentration has ***fluctuated from year to year, but has overall improved*** since monitoring began. After 10 consecutive years of sample collection, we will be able to conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean chlorophyll-a concentration since monitoring began in 1989. *(Please note that the deep spot was not sampled in 1996, 1997, or 2000.)*

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

  The current year data (the top graph) show that the in-lake transparency ***decreased consistently*** from June to September this season. *(Again, please remember that the deep spot was not sampled in July.)*

Overall, visual inspection of the historical data trend line (the bottom graph) shows ***a stable*** trend for in-lake transparency. Specifically, since monitoring began in 1989, the mean annual transparency has ***ranged between approximately 1.5 and 2.1 meters***. As discussed previously, after ten consecutive years of sample collection, we will conduct a statistical analysis of the historic data to objectively determine if there has been a significant change in the annual mean transparency since monitoring began.

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) and the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***increased*** from June to September. The phosphorus concentration on each sampling event was ***greater than*** the state median. *(Please note that the epilimnion was sampled in August while the hypolimnion was not sampled.)*

The historical data show that the 2003 mean epilimnetic and hypolimnetic phosphorus concentration is ***greater than*** the state median.

Overall, visual inspection of the historical data trend line for the epilimnion show ***a fluctuating, but overall decreasing (meaning improving)***, phosphorus trend since monitoring began.

Overall, visual inspection of the historical data trend line for the hypolimnion shows ***a variable*** phosphorus trend, which means that the concentration has ***fluctuated*** since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**

  Table 2 (Appendix B) lists the current and historic phytoplankton species observed in the lake. The dominant phytoplankton species observed this year were ***Dinobryon*** **(a golden-brown algae),** ***Asterionella*** **(a diatom),** ***and Synedra*** **(a diatom).**

  Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

- **Table 2: Cyanobacteria (Blue-green algae)**

  A **small amount** of the cyanobacterium ***Microcystis*** was observed in the plankton sample this season. ***This species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.***

  Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. During September of 2003, a few lakes and ponds in the southern portion of the state experienced cyanobacteria blooms. This was likely due to nutrient loading to these waterbodies. As mentioned previously, many weeks during the Spring and Summer of 2003 were rainy, which likely resulted in a large amount of nutrient loading to surface waters.

  The presence of cyanobacteria serves as a reminder of the lake's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake by eliminating fertilizer use on lawns, keeping the lake shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to "pile" cyanobacteria into scums that accumulate in one section of the lake. If a fall bloom occurs, please contact the VLAP Coordinator.

- **Table 4: pH**

  Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

  pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

  The mean pH at the deep spot this season ranged from **6.68** in the hypolimnion to **6.57** in the epilimnion, which means that the water is ***slightly acidic.***

  Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake pH.

- **Table 5: Acid Neutralizing Capacity**

  Table 5 (Appendix B) presents the current year and historic epilimnetic ANC for each year the lake has been monitored through VLAP.

  Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report. The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) was **6.87** which is ***slightly greater than*** the state mean. Specifically, this indicates that the lake is ***highly sensitive*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**
  Table 6 (Appendix B) presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  The conductivity has ***increased*** in the deep spot of the lake since monitoring bean. Specifically, in 1989 the mean conductivity in the epilimnion was **74.8 uMhos/cm** while in 2003 the mean conductivity was **137.0 uMhos/cm**.

  In addition, the conductivity has ***increased greatly*** in the **Inlet, Twin Beach Inlet, and the Outlet** since monitoring began.

  Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

  A shoreline conductivity survey was conducted in mid-summer by the volunteer monitor. The results of the survey did not indicate specific sections along the shoreline where the conductivity was particularly elevated.

  It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity the lake. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

  Therefore, we recommend that the **epilimnion**, the **Inlet**, and **Twin Beach Inlet** be sampled for chloride next season. This sampling may help us pinpoint what areas of the watershed are contributing to the increasing in-lake conductivity.

Please note that there will be an additional cost for each of the chloride samples.

- **Table 8: Total Phosphorus**

  Table 8 (Appendix B) presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  Storm event sampling was conducted by the volunteer monitor on August 1. Six locations were sampled for phosphorus and the concentrations ranged from **18 ug/L to 176 ug/L**. The phosphorus concentration was ***particularly elevated*** in the **Black Flex Pipe (51 ug/L), Wetland Side of Inlet (71 ug/L), Main Beach Left (123 ug/L), and the West Pipe (176 ug/L).** (It is important to note that the turbidity of these samples was ***slightly elevated***, which suggests that soil erosion may be contributing to the elevated phosphorus levels.)

  Many of these locations were re-sampled on August 7 after a period of dry weather. The phosphorus concentrations on the August 7 sampling event generally lower. While stormwater sampling is a helpful was to better pinpoint sources of elevated pollutants, it is difficult to draw any conclusions based on the information that was supplied with the August samples. Specifically, when conducting storm water sampling, please identify sampling locations and station names on a map. When you re-sample during dry periods, please again identify sampling locations and station names on a map, and please collect dry weather samples in the sample location as the wet weather samples were collected. Furthermore, please use a consistent station naming system.

  We suggest that your monitoring group conduct dry weather and wet weather sampling in the beach area again next season.

  For a detailed explanation on how to conduct storm event and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article", or contact the VLAP Coordinator.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

  Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was ***high*** at all depths sampled at the deep spot of the lake. Typically, shallow lakes and ponds that are not deep enough to stratify into more than one or two layers will have relatively high amounts of oxygen at all depths. This is due to continual lake mixing and diffusion of oxygen into the bottom waters induced by wind and wave action.

- **Table 11: Turbidity**
  Table 11 (Appendix B) lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

  The turbidity levels in storm event samples collected on August 1, were ***elevated***. In particular, the turbidity in the **Wetland Side of Inlet** sample was **6.6 NTUs**, which suggests that erosion is occurring in this portion of the watershed.

- **Table 12: Bacteria (*E.coli*)**
  Table 12 lists the current year data for bacteria *(E.coli)* testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful disease-causing organisms may also be present.

  As discussed previously, storm event sampling was conducted on August 1. The *E.coli* concentration in three of the samples was ***very high***. Specifically, the concentrations were as follows; **Main Beach Left** (2170 counts per 100 mL), **Wetland Side of Inlet** (2000 counts per 100 mL), and **East West Pipe** (2000 counts per 100 mL). These results were ***much greater than*** the state standard of 88 counts per 100 mL for designated public beaches and 406 counts per 100 mL for recreational waters that are not designated beaches.

  On August 7, *E.coli* sampling was conducted in many locations after a period of dry weather. Overall, the results were ***relatively low*** on this event. However, the results were ***slightly elevated*** at the **Twin Beach Inlet** (120 counts per 100 mL) and the **Wetland Side of Inlet**

(80 counts per 100 mL). *(Please note that it is unclear if all of the stations that were sampled on the August 1 storm event were also sampled on the August 7 sampling event.)*

The results from both the storm event and dry weather sampling indicate that the *E.coli* concentration may be elevated in the lake in the vicinity of the beach. However, the *E.coli* results from the 2003 sampling season are *not conclusive*.

We suggest that your monitoring group conduct dry weather and wet weather sampling in the beach area again next season. Please make sure to indicate the sampling locations and station names on a map and submit this map to DES with your samples. If the *E.coli* results continue to be elevated, we will likely have a DES biologist conduct further investigations in the area.

The Governors Lake beach is not sampled through the NH DES Beach Program. A beach at Onway Lake in Raymond is sampled through the DES Beach Program, and we suggest that Governors Lake join the program as well.

In addition, DES recommends that the Governors Lake Association join the DES Adopt-a-Beach Program. The Association could conduct weekly, bi-weekly, or monthly sampling bacterial sampling, and after storm events (which DES would likely be able to assist with).

For more information about the Beach Program, please contact Sara Sumner, Beach Program Coordinator, at 271-8803 or ssumner@des.state.nh.us.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake, the biologist conducted a "Sampling Procedures Assessment Audit" for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor's Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an ***excellent*** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did a ***very good*** job when collecting samples this season! Specifically, the members of your monitoring group followed the majority of the proper field sampling procedures when collecting and submitting samples to the laboratory. However, the laboratory did identify one aspect of sample collection that the volunteer monitors could improve upon.

- **Station Identification:** When submitting stormwater samples to the laboratory, please include a sampling map that identifies each sampling location and station name. This will help DES to interpret the results and to classify the data.

NOTES

- **Monitor's Note (6/27/03):** Lots of beaver activity was observed
  (8/7/03): 2 great blue herons, 1 beaver, around 20 ducks, and around 4 geese were observed. 2-4 inches of rainfall in the past week.
  (9/4/03): Large duck population observed

- **Biologist's Note (8/1/03):** The E. Coli counts at Main Beach Left, Main Inlet Wetland, and Outfall E. West Pipe were very high. In addition, the total phosphorous levels at Main Beach Left and Outfall E. West Pipe were very high. We suggest contacting DES and scheduling a site visit with a biologist within the next few months.

(8/7/03): The *E.coli* concentration at the Twin Beach Inlet was elevated. While *E.coli* levels are less than what was observed during the previous week storm event sampling, we recommend that additional storm event sampling be conducted.

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, *NHDES-WD 97-8*, NHDES Booklet, (603) 271-3503.

Camp Road Maintenance Manual: A Guide for Landowners. KennebecSoil and Water Conservation District, 1992, (207) 287-3901.

Comprehensive Shoreland Protection Act, RSA 483-B, *WD-SP-5,* NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-5.htm.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-1.htm

Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or www.des.state.nh.us/factsheets/wqe/wqe-7.htm

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, *WD-BB-9*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

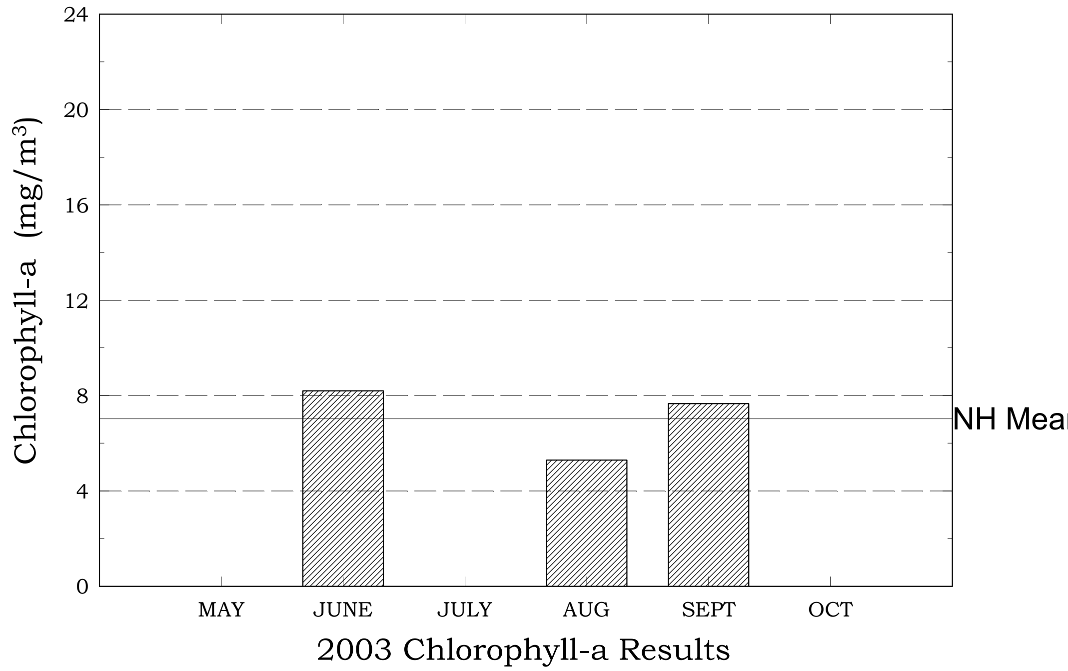
Sand Dumping - Beach Construction, *WD-BB-15*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

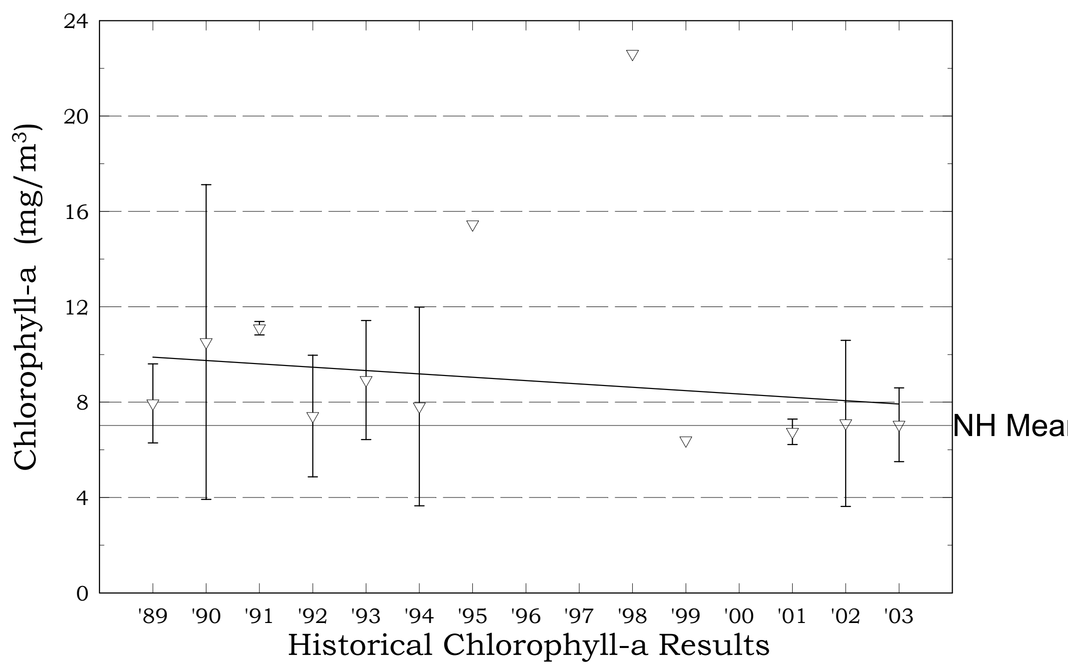
APPENDIX A

GRAPHS

Governors Lake, Raymond

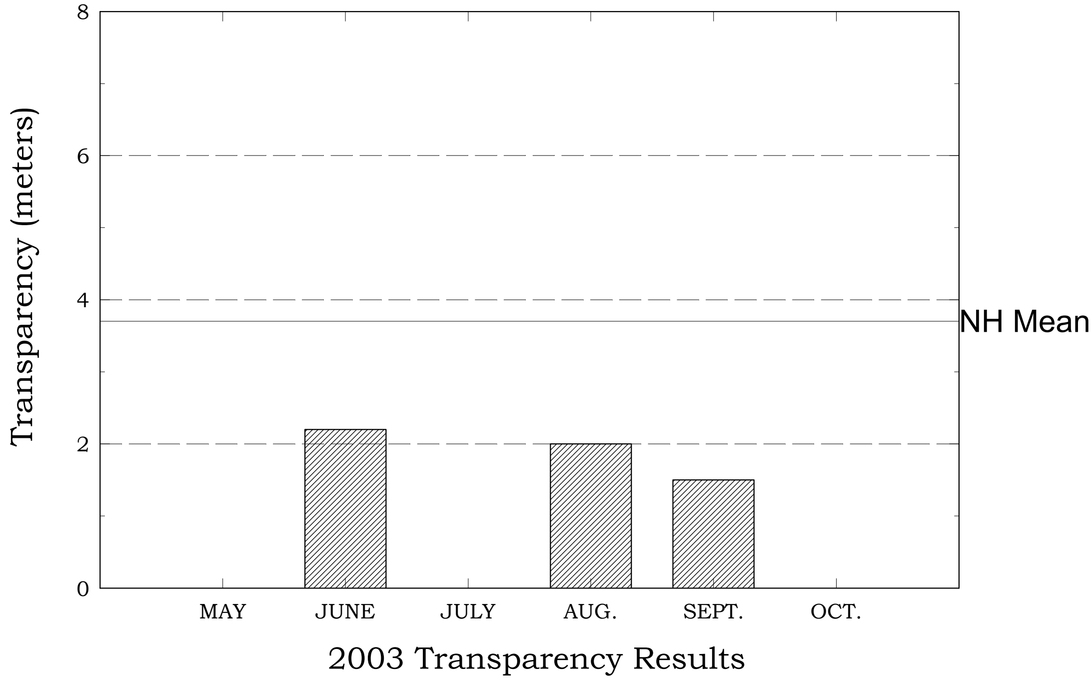
Figure 1. Monthly and Historical Chlorophyll-a Results

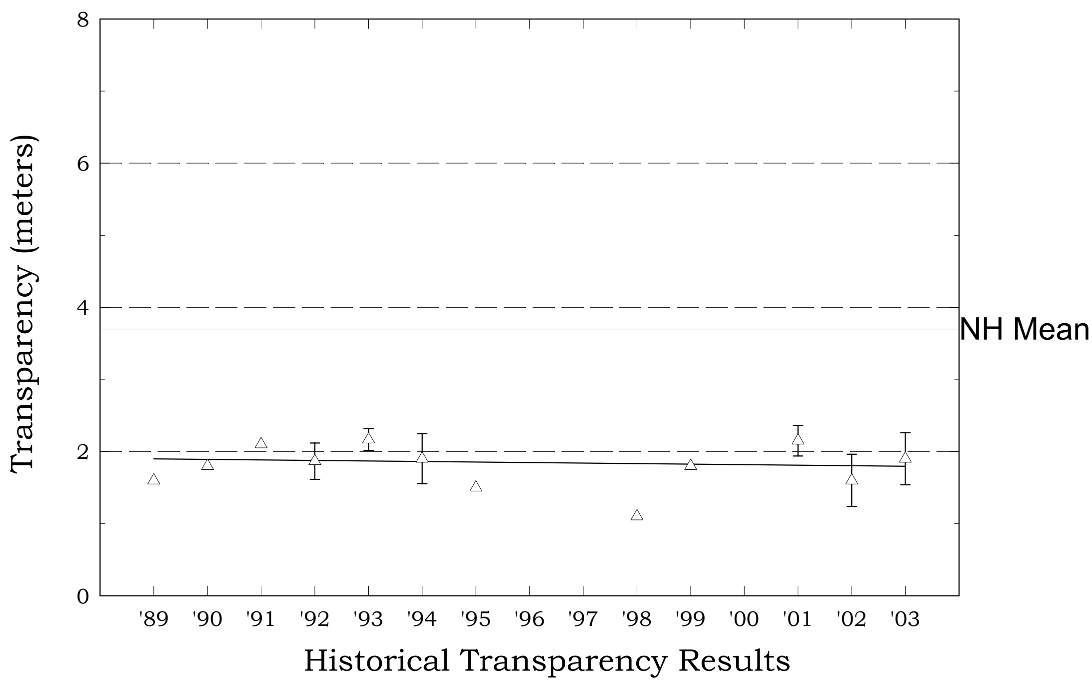




Governors Lake, Raymond

Figure 2. Monthly and Historical Transparency Results





Governors Lake, Raymond

Figure 3. Monthly and Historical Total Phosphorus Data.